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# Clinical experience with and analytical confirmation of "bath salts" and "legal highs" (synthetic cathinones) in the United States

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Recently, there has been a worldwide rise in the popularity and abuse of synthetic cathinones. In 2009 and 2010, a significant rise in the abuse of a new group of synthetic cathinones was reported in Western Europe. In 2010, the rapid emergence of a new drug of abuse, referred to as bath salts or "legal high," occurred in the USA. The growing number of cases along with the alarming severity of the effects caused by the abuse of these substances prompted significant concern from both healthcare providers and legal authorities. We report the experience of the first 8 months of two regional poison centers after the emergence of a new group of substances of abuse. *Method*. This was a retrospective case series of patients reported to two poison centers with exposures to bath salts. Additionally, 15 "product samples" were obtained and analyzed for drug content using GC/MS. *Results*. There were 236 patients of which 184 (78%) were male. Age range was 16–64 years (mean 29 years, SD 9.4). All cases were intentional abuse. There were 37 separate "brand" names identified. Clinical effects were primarily neurological and cardiovascular and included: agitation (n = 194), combative behavior (n = 134), tachycardia (n=132), hallucinations (n = 94), paranoia (n = 86), confusion (n = 83), chest pain (n = 40), myoclonus (n = 45), hypertension (n= 41), mydriasis (n = 31), CPK elevations (n = 22), hypokalemia (n = 10), and blurred vision (n = 7). Severe medical outcomes included death (n=1), major (n = 8), and moderate (n = 130). Therapies included benzodiazepines (n = 125), antipsychotics (n = 47), and propofol (n=10). Primary dispositions of patients were: 116 (49%) treated and released from ED, 50 (21%) admitted to critical care, 29 (12%) admitted to psych, and 28 (12%) lost to follow up. Nineteen patients had blood and/or urine analyzed using GC/MS. MDPV was detected in 13 of 17 live patients (range 24–241 ng/mL, mean 58 ng/mL). The four samples with no drug detected, reported last use of bath salts >20 h prior to presentation. Three of five patients had MDPV detected in urine (range 34–1386 ng/mL, mean 856 ng/mL). No mephedrone or methylone was detected in any sample. Quantitative analysis performed on postmortem samples detected MDPV in blood at 170 ng/mL and in urine at 1400 ng/mL. No other synthetic cathinones were detected. *Discussion*. This is the first report of MDPV exposures with quantitative blood level confirmation. Clinical effects displayed a sympathomimetic syndrome, including psychotic episodes often requiring sedation, movement disorders, and tachycardia. Within 8 months of their appearance, 16 states had added synthetic cathinones to the controlled substances list as a Schedule I drug. *Conclusion*. We report the emergence of a new group of substances of abuse in the USA, known as bath salts, with quantitative results in 18 patients. State and federal authorities used timely information from poison centers on the bath salt outbreak during investigations to help track the extent of use and the effects occurring from these new drugs. Close collaboration between state authorities and poison centers enhanced a rapid response, including legislation.

**Keywords** Synthetic cathinone; Designer drugs; Stimulants; Sympathomimetic syndrome; Drugs of abuse

## Introduction

Recently, there has been a worldwide rise in the popularity and abuse of synthetic cathinones. Abuse of one synthetic cathinone – methcathinone – occurred for several decades in the former Soviet Union, Russia, and Eastern Europe and spread to the West in the 1990s.[1–3] Methcathinone reportedly had been developed in the former Soviet Union as an antidepressant in the 1930s and separately developed in the West in the 1950s as an appetite suppressant, but was never marketed due to its strong addictive potential. In 2009 and 2010, a significant rise in the abuse of a new group of synthetic cathinones was reported in Western Europe.[4–11] In 2010, the first cases of exposure to products marketed as "legal highs" and bath salts were reported to US poison centers. Based on the increased use in Europe and availability on the Internet for similar "legal highs," these products were believed to contain various synthetic cathinones, including mephedrone (4-methylenemethcathinone), MDPV

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(methylenedioxypyrovalerone), methylone (3,4-methelendioxy-n-methylcathinone), methedrone (4-methoxymethcathinone), and fluorormethcathinone.[12,13] The product packages were labeled as bath salts, insect repellants, stain removers, and plant food. However, the users of these products openly spoke of using them as "legal methamphetamine" or "legal cocaine." The product labels did not provide any indication of the true active ingredients. Unlike the European experience, where many of the products were being purchased from a "dealer" or over the Internet, in the USA the majority of the new "bath salt" products were being purchased locally in small independent stores, such as gas stations, smoke shops, and "head shops." The growing number of cases along with the alarming severity of the effects caused by the abuse of these substances prompted significant concern from both healthcare providers and legal authorities. During this period in 2010, there was limited information about what these "products" actually contained or the clinical effects that would be expected from abuse of these substances. We report the experience of the first 8 months of two regional poison centers after the emergence of a new group of substances of abuse.

## Methods

A retrospective search was performed at two poison centers for all records involving what came to be known as bath salts, for the period January 2010 through February 2011. An initial search was performed to locate any case with a substance name listed as bath salts, insect repellant, stain remover, plant food, MDPV, mephedrone, methylone, cathinones, white lightening, zoom, blue silk, red dove, ivory wave, white cloud, cloud 9, cloud 10, dynamite, or unknown drug. Poison center case notes were then reviewed to verify if there was documentation that the substances involved an illicit "bath salt" case. In November 2010, both poison centers had agreed to code all these exposures under the term "bath salts". Product names and descriptions were obtained from the documentation in the case notes. Both centers utilize the electronic medical record system Toxicall, which allows review of the record stripped of personal identifiers. All charts were then reviewed by the investigators to verify the substance from the case notes. Calls were received from both the general public and hospitals/healthcare facilities. Toxicall allows storage of all calls and consultations on a specific patient in a single medical record, so that each case involved in this study was included only once, despite multiple calls and consultations of many of these patients. Data obtained included age, gender, substance involved, reason for exposure, history of use if obtained, clinical effects, pertinent laboratory values, therapies administered, and medical outcome. Medical outcome designation was the standard American Association of Poison Control Center categories utilized by poison centers.[14] In a number of cases, because of the confused, agitated, or delusional mental state of the patient, the history of use and any previous abuse history were obtained from significant others of the patient.

During December 2010, because of the lack of information on the contents of these new "products," 15 products in their sealed original containers were obtained from separate commercial locations (stores) in the two states for analysis of content.

Blood/serum and/or urine waste samples were obtained from 18 patients for analysis as an initial effort to discover what substances might be involved in the toxidrome displayed by the patients. This was part of a public health response to what was considered as an outbreak of a newly emergent substance of abuse. All samples were obtained during initial patient presentation and examination in the emergency department and were obtained after initial clinical use (if any) had been performed.

### *Chemicals and reagents*

Analytical reference standards for MDPV, mephedrone, methcathinone, and phencyclidine (the latter two used for internal standards) were obtained from Cerilliant. MDPV was received as the powdered HCl salt. A 1 mg/mL (calculated as the free base) stock solution was prepared from this solution by dissolving 11.3 mg MDPV HCl in 10 mL DI water. Mephedrone, methcathinone, and phencyclidine were received as 1 mg/mL solutions. Blank blood was donated by a local blood bank and determined to be drug free by GC/MS analysis.

### *Analysis of purchased products*

After dissolution in methanol, the products were each analyzed using an Agilent 7890A gas chromatograph coupled to an Agilent 5975C mass spectrometer. The column was an Agilent DB-1 (100% dimethylpolysiloxane) (12 m $\times$ 0.2 mm $\times$ 0.33 μm). Ultra-pure helium was used as the mobile phase using a constant flow of 0.80 mL/min. Other instrumental parameters included: 1 μL injection, split ratio 300:1, injection port 290°C, oven program 100°C for 15 sec, ramped at 65°C/min to 220°C, then at 40°C to 290 with a final hold time of 6.15 min. The total analysis time was 10 min. The mass spectrometer was programmed with a transfer line temperature of 290°C, source temperature of 230°C, quadrupole temperature of 150°C, solvent delay of 0.85 min, and was operated in scan mode from 50 to 550 m/z for the duration of data collection. Identification of the substances present in the bath salts was determined by retention time and mass spectral comparison of the GC/MS data to known standards.

### *Quantitation of biological specimens*

For the quantitation of the bath salt drugs in biological specimens, methcathinone and phencyclidine were used as internal standards. The internal standard solution was made by combining 25 μL aliquots of the 1 mg/mL methcathinone and phencyclidine standards and diluting to 25 mL with DI water, resulting in a 1 μg/mL solution for each drug. Similarly, a 1 μg/mL solution containing both mephedrone and MDPV was prepared by diluting 25 μL of each of the 1 mg/mL solutions to 25 mL DI water.

Mephedrone and MDPV calibrators with concentrations of 25, 50, 75, 100, and 150 ng/mL were prepared by pipetting



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appropriate volumes of 1 μg/mL solution into 1 mL aliquots of blank blood obtained from a local blood bank and determined to be drug free by GC/MS analysis.

*Sample preparation*

The calibrators, 1 mL aliquots of biological specimens, and a 1 mL aliquot of blank blood were pipetted into culture tubes and then extracted using the following procedure. Internal standard (50 μL) was added to each sample, followed by 1 mL of borate buffer. After briefly mixing the samples by vortex, 4 mL of n-butyl chloride was added to each sample. Each tube was capped and shaken for 2 min, followed by centrifugation at 3000 rpm for 3 min. After transferring the resulting organic layer to a 5-mL conical centrifuge tube, 2 mL of 1.0 N HCl was added. The conical tubes were capped and placed on a rotary extractor for 15 min, followed by another 3 min centrifugation at 3000 rpm. The organic layer was discarded. Seven drops (approximately 350 μL) of conc. $NH_4OH$ was added to each to basify the aqueous solution. Chloroform (75 μL) was added, and the samples were capped, shaken for 2 min, and centrifuged again at 3000 rpm for 3 min. The resultant chloroform layer was transferred into autosampler vials and then analyzed by GC/MS.

*Analysis*

Determination of blood concentration and/or urine concentration was performed using another Agilent 7890A/5975C GC/MS. This instrument was equipped with a DB-1 column having dimensions of 30 m × 0.320 mm × 0.25 μm. For biological samples, 2 μL of extract was injected in splitless mode. Other instrumental parameters: injection port 250°C, ultra-pure helium column flow 1.788 mL/min, oven initial temperature 60°C for 1 min, then 15°C/min ramp to 300°C with a hold time of 3 min, total run time 20 min. The mass spectrometer transfer line, source, and quadrupole temperatures were 280, 230, and 150°C, respectively. The mass spectrometer scanned from 40 to 400 m/z after a solvent delay of 3 min.

## Results

The first case was reported in August 2010 in Kentucky and the first case in Louisiana occurred in September 2010. From August 2010 through February 2011, there were 236 patients with a rapid escalation in the number patients reported after November 2010 (see Fig. 1). The majority of patients (n = 184, 78%) were male. The age range was from 16 to 64 years (mean 29 years, SD 9.4). All cases reported the reason for exposure as intentional abuse. Where history was available, a large number of cases reported previous abuse of methamphetamine and/or cocaine and the use of bath salts as a "legal" replacement for these substances. Results from qualitative urine drug screens were recorded in 44 patients and detected positive results for amphetamines, barbiturates, benzodiazepines, caffeine, cannabinoids, cocaine, MDMA, methadone, opiates, oxycodone, and oxymorphone. There were 39 separate "brand" names identified from patient histories (Table 1). In 72% of cases, the originating contact call was from the hospital, with 6% originating from EMS/ambulance service and 22% from the public.

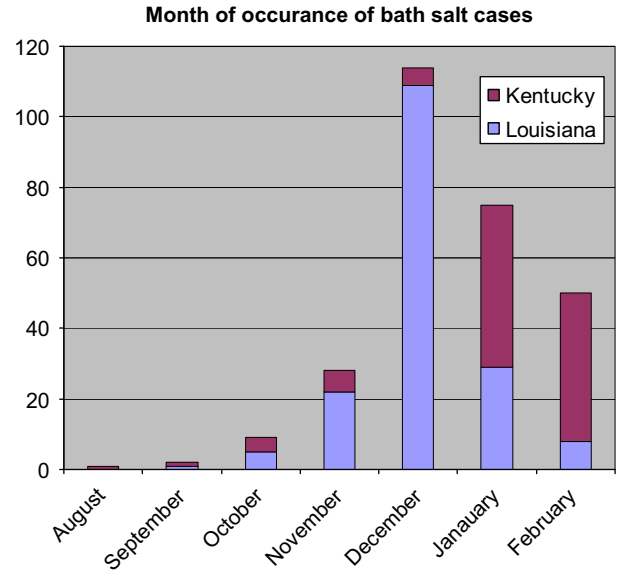


**Fig. 1.** Month of occurrence of synthetic cathinone cases by state (see colour version of this figure online).

Clinical effects were primarily neurological and cardiovascular and are reported in Table 2. Severe medical outcomes included: death (n = 1), major (n = 8), and moderate (n = 130). The single fatality occurred in a 21-year-old male from a self-inflicted gunshot after an active delusional episode witnessed by family members. A number of alarming and dangerous behaviors (to either self or others) were reported in these patients in temporal association with acute use of large amounts or prolonged use of "bath salts" over several days to several weeks. Examples of these new onset behaviors in separate patients included: jumping out of a window to flee from non-existent pursuers; requiring electrical shock (Taser) and eight responders to initially subdue the patient; repeatedly firing guns out of the house windows at "strangers" who were not there; walking into a river in January to look for a friend who was not there; leaving a 2-year-old daughter in the middle of a highway because she had demons; climbing into the attic of the home with a gun to kill demons that were hiding there, and breaking all the windows in a house and wandering barefoot through the broken glass.

Therapies were primarily sedation and treatment for persistent myoclonus and included the benzodiazepines diazepam, lorazepam, and/or midazolam (n = 125, 53%), the antipsychotics haloperidol and ziprasidone (n = 47, 20%), propofol (n = 10, 4%), and diphenhydramine (n = 2, 1%). The dispositions of patients were: 116 (49%) treated and released from the emergency department, 50 (21%) admitted to a critical care unit, 29 (12%) admitted to behavioral health/psychiatry, 28 (12%) were lost to follow up, and 13 (6%) were managed at a non-healthcare facility.

Eighteen live patients had blood and/or urine analyzed using GC/MS. MDPV was detected in the blood/serum of 13 of 17 patients (range 24–241 ng/mL, mean 58 ng/mL).

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**Table 1.** Names of products reported by users.

| Product name | Frequency of reports |
|---|---|
| Artic blasting station | 1 |
| Atomic | 1 |
| Bayou revitalisant | 1 |
| Blaze | 1 |
| Blitz | 2 |
| Blue moon | 1 |
| Blue silk | 5 |
| Bohemian bath salts | 2 |
| Bolivian bath salts | 2 |
| Dr. booga shooga | 3 |
| Cloud 9 | 73 |
| Cloud 10 | 2 |
| Columbian odorizer | 1 |
| Cotton cloud | 4 |
| Dream | 1 |
| Dynamite | 1 |
| Euphoria | 1 |
| Hurricane charlie | 1 |
| Ivory wave | 9 |
| Ivory wave ultra | 1 |
| Kush blitz | 1 |
| Lady bubbles | 2 |
| Legal | 2 |
| Love potion 69 | 2 |
| Moon dust | 4 |
| Night cap | 1 |
| NRG-1 | 1 |
| Q concentrated | 1 |
| Red dove | 1 |
| Resin | 1 |
| Scar face | 1 |
| Serenity | 1 |
| Super clean stain remover | 1 |
| White cloud | 1 |
| White diamonds | 2 |
| White dove | 1 |
| White girls bath salts | 1 |
| White lightening | 24 |
| Zoom | 6 |

The four samples with no synthetic cathinone detected, reported last use of bath salts >20 h prior to presentation. Additional drugs detected in the blood/serum included citalopram, diazepam, diphenhydramine, hydrocodone, and zolpidem. Three of five patients had MDPV detected in urine (range 34–1386 ng/mL, mean 856 ng/mL). Additional drugs detected in the urine were alprazolam, citalopram, diphenhydramine, hydrocodone, and methamphetamine. No mephedrone or methylone was detected in any sample. Ethanol detection was not included in analysis. Quantitative analysis was performed on postmortem samples in the single fatality. MDPV was detected in blood at 170 ng/mL and in urine at 1400 ng/mL. No other synthetic cathinones were detected.

Fifteen products in their sealed original containers were obtained from separate locations in the two states. The products contained one or more of three of the known synthetic cathinones: 4-methylmethcathinone (mephedrone), methylenedioxypyrovalerone (MDPV), or 4-methylenedioxy-N-methylcathinone (methylone). Additional substances found included caffeine and an unidentified substance (see Table 3).

## Discussion

We report the largest series of synthetic cathinone exposures with a number of important features, including a high incidence of new onset severe neurological/psychiatric changes; qualitative results of the contents of "bath salts"; and quantitative results of blood and urine in synthetic cathinone users.

Previous reports of synthetic cathinone use/abuse have focused primarily on mephedrone and have reported clinical effects consistent with a sympathomimetic syndrome, including tachycardia, agitation, hypertension, palpitations, chest pain, confusion, paranoia, hallucinations, violent behavior, and seizure.[4–6,8] Our results are consistent with these previous reports. However, in our case series, we found aggressive violent behavior, hallucinations, and paranoia in higher percentages than previously reported. It is interesting to note that the high incidence of neurological/psychiatric changes occurred in a population that had pre-existing experience in illicit stimulant abuse, such as cocaine and methamphetamine, who had not previously reported episodes of neurological/psychiatric changes of such severity. The increased incidence may have occurred for a number of reasons. Experience with misuse/abuse of this drug is limited. While the reported incidence pattern is different from previous reports of synthetic cathinone abuse, the clinical effects reported are similar, and this may simply be a reflection of a difference in dosing patterns or patient populations (e.g. "club" drug use vs. street drug abuse). Another possibility is that this may represent a difference in clinical patterns from the individual synthetic cathinones, perhaps based on subtle differences in the effects on neurotransmitters.[15–17] The previous reports from the European experience primarily involved mephedrone. However, in our case series, all verified serum or urine samples contained MDPV, with no detected mephedrone or methylone. This second possibility should be viewed with caution as only 6% of patients in our series had laboratory verification of their exposure. Movement disorders may also be a differentiating factor. A previously unreported finding in our series was myoclonus in 19% of the patients and elevated CPK in 9% of the patients. One report of "ivory wave" exposure, which may have involved MDPV, reported involuntary facial contortions, supporting a possible movement disorder as a clinical effect with MDPV abuse.[18] Previous reports of a parkinsonian syndrome associated with methcathinone have been attributed to a manganese contamination during illicit preparation of the drug.[1,2]

Analysis of the "legal high" or "bath salt" products revealed a combination of three synthetic cathinones: mephedrone, methylone, and MDPV. This is similar to the European experience, with some differences.[12,19] In the USA, the primary synthetic cathinone available was not mephedrone, and the main distribution point was through small local stores. We believe that the wide availability, coupled with the ease of anonymous local purchase and inexpensive



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**Table 2.** Reported clinical effects.

| Clinical effect | No. of patients with reported effect (% of total patient group) | Comments |
|---|---|---|
| Agitation | 194 (82%) | |
| Combative violent behavior | 134 (57%) | |
| Tachycardia | 132 (56%) | Mean heart rate for those with reported tachycardia was 124 (SD 15.5) with a range of 100–178 beats per minute |
| Hallucinations | 94 (40%) | |
| Paranoia | 86 (36%) | |
| Confusion | 83 (34%) | |
| Myoclonus | 45 (19%) | |
| Hypertension | 41 (17%) | |
| Chest pain | 40 (17%) | |
| Mydriasis | 31 (13%) | |
| CPK elevations | 22 (9%) | Mean reported CPK elevation was 1825 U/L with a range of 301–4400 U/L |
| Hypokalemia | 10 (4%) | Mean reported potassium for those with hypokalemia was 2.9 mEq/L with a range of 2.1–3.4 mEq/L |
| Blurred vision | 7 (3%) | |
| Catatonia | 1 (1%) | |

Definitions: Tachycardia was a heart rate >99 bpm; hypertension was systolic pressure >170 mmHg or diastolic pressure >90 mmHg; hypokalemia K <3.5 mEq/L, CK elevation CPK >250 U/L.

products, allowed a rapid expansion of these drugs into the market. In many cases, they were easier to obtain than beer or cigarettes. Additionally, no ingredients were listed on the packaging. Unlike web sites that may allude to ingredients that the knowledgeable prospective customer might recognize and/or desire, the bath salt products were primarily sold in small stores by clerks with little or no knowledge of what the product might contain. Analysis of two "brand names" (white lightening and dynamite), which were obtained at different locations, revealed different synthetic cathinones as the primary ingredient, despite similar appearing packaging. The 15 products analyzed and reported here were purchased in December 2010 and may not represent the psychoactive substances in future "bath salt" or "legal high" products. A wide variety of novel psychoactive substances are available and may replace the substances detected in the present group of products.[12,24]

Quantitative analysis showed serum levels of 24–241 ng/mL of MPV. Previous serum MDPV concentrations in live patients have not been reported, but these concentrations are in the range of the mephedrone level (0.15 mg/L) reported by Wood et al.[20] A limitation of interpreting these blood/serum levels of MDPV is that the time from use of the drug to the time of obtaining the sample is not known. We believe this is the first report of postmortem quantitative MDPV concentrations. Postmortem concentrations in five fatalities associated with another synthetic cathinone, mephedrone, ranged from 0.13 to 5.1 mg/L.[4,5] Urine concentrations after abuse of MDPV have recently been reported in Finland in a group of opioid-dependent patients undergoing opioid substitution therapy.[21] The similarities between our patient group and the report by Ojanpera et al. were the reported use of MDPV as a substitute for illicit amphetamine and similar urine concentrations. This suggests that urine may be a useful medium to detect previous MDPV abuse.

**Table 3.** Ingredients detected in "bath salt" samples.

| Product name | Drug found | Labeled "use" | Physical appearance |
|---|---|---|---|
| White lightening | Mephedrone | Insect repellent | White dry powder |
| White lightening | MDPV | Natural stain remover | White dry powder |
| Zoom | MDPV | Bath salt | Beige powder |
| Energizing aromatherapy powder | MDPV and caffeine | Potpouri | Beige powder |
| Euphoria | Methylone and caffeine | Bath salt | Beige powder |
| Cotton cloud | Mephedrone, methylone, and MDPV | Bath salt | White crystalline powder |
| Cloud 9 | Methylone and MDPV | Bath salt | Beige powder |
| Bayou ivory flower | Mephedrone | Bath salt | Beige powder |
| Cloud 10 | MDPV | Not on product | Beige powder |
| White dove | Methylone | Bath salt | Beige powder |
| Dynamite | Methylone | Bath salt | White dry powder |
| Dynamite "plus" | MDPV | Bath salt | Beige powder |
| White china | MDPV and unknown compound | Bath salt | Beige powder |
| Snow day | Methylone and MDPV | Bath salt | Beige powder |
| Bolivian bath salts (scarface) | MDPV | Bath salt | White dry powder |

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Little is known of the mechanism of action of synthetic cathinones, but a clinical picture of a sympathomimetic syndrome has become evident. Methcathinone and methylone appear to inhibit membrane catecholamine transporters, suggesting a reuptake inhibition. Comparison of methcathinone and methylone to methamphetamine and methylenedioxymethamphetamine (MDMA) showed similar effects on dopamine and norepinephrine reuptake inhibition, but methylone with its 3,4-methylenedioxy group showed increased serotonin reuptake inhibition.[15] Animal studies with methylone showed potent monoamine release effects for dopamine and serotonin and less so for norepinephrine, and reflected reuptake inhibition of dopamine, norepinephrine, and serotonin.[16] In a mouse model, MDPV increased dopamine concentrations but did not appear to affect serotonin concentrations.[17] While the mechanism is not yet fully elucidated, it appears that the behavioral toxicity (including self-injurious behavior and schizophrenic-like psychoses) and movement disorders of synthetic cathinones may have a dopaminergic mechanism similar to amphetamines.[22,23]

Within 8 months of their appearance on the US market, more than 1400 cases of misuse and abuse of "bath salts" had been reported to US poison centers in 47 of 50 states. On 6 January 2011, Louisiana passed an emergency rule placing six synthetic cathinones in Schedule I. The substances banned were 3,4-methylenedioxymethcathinone (methylone), 3,4-methylenedioxypyrovalerone (MDPV), 4-methylmethcathinone (mephedrone), 4-methoxymethcathinone (methedrone), 3-fluromethcathinone, and 4-fluoromethcathinone (flephedrone). The number of cases reported in Louisiana decreased dramatically after the ban was put in place on 6 January 2011 (Fig. 1). Within 3 months of this, 15 more states added synthetic cathinones to the controlled substances list as Schedule I drugs, either through temporary emergency rule or direct legislation (Kentucky, Alabama, Arkansas, Florida, Hawaii, Illinois, Idaho, Mississippi, North Dakota, Oregon, Utah, Virginia, Washington, Wisconsin, and Wyoming). Legislation is pending in a number of additional states. Timely information from poison centers on the bath salt outbreak was used by state and federal authorities during investigations to help track the extent of use and effects occurring from these new drugs. Close collaboration between state authorities and poison centers enhanced a rapid response, including legislation.

## Conclusion

We report the emergence of a new group of substances of abuse in the USA, known as bath salts, with quantitative results of MDPV use in 19 patients. Calls to US poison centers as a result of the use and abuse of these drugs were first noted in 2010. Rapid analysis and identification of the synthetic cathinones involved in these substances as well as the coordinated response by two poison control centers have permitted a picture of this new epidemic to be presented. The growing number of cases together with the alarming severity of the effects caused by the abuse of these substances prompted significant concern from both healthcare providers and legal authorities. Since the emergence of these bath salts, a growing number of states have designated six synthetic cathinones as Schedule I controlled substances. However, there are a large number of potential novel psychoactive "designer" drugs that may possibly be distributed in the future.[24] Changes to specific moieties may not be addressed in the current legislation, leaving clinical toxicologists, poison centers, and emergency physicians to face an on-going pattern of chasing the next ivory wave.

## Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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